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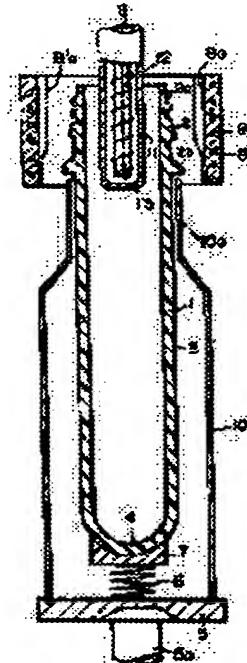
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(54) CRYSTALLIZATION OF PLASTIC MOLDED OBJECT

(57)Abstract:

PROBLEM TO BE SOLVED: To crystallize the mouth neck part of a plastic molded object comprising a thermoplastic polyester resin within an extremely short time while holding the shape of a screw part or the like normally.

SOLUTION: The inner and outer surfaces of the mouth neck part 2 of a plastic molded object 1 comprising a thermoplastic polyester resin are irradiated with infrared rays to heat the mouth neck part 2 to crystallization temp. Thereafter, heating is stopped to advance crystallization and, subsequently, the mouth neck part 2 is quenched. Or, the inner and outer surfaces of the mouth neck part 2 are irradiated with infrared rays to heat the mouth neck part 2 to the temp. equal to or higher than the glass transition point of the thermoplastic polyester resin and, thereafter, the mouth neck part is heated to its crystallization temp. in a microwave cavity resonator by induction heating and this heating is subsequently stopped to advance crystallization and, subsequently, the mouth neck part 2 is quenched.



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【特許請求の範囲】

【請求項1】 熱可塑性ポリエステル樹脂よりなるプラスチック成形体の口頸部の内外面に赤外線を放射して、口頸部を結晶化温度に加熱した後、加熱を止めて結晶化を進行させ、次いで口頸部を急冷することを特徴とするプラスチック成形体の結晶化方法。

【請求項2】 熱可塑性ポリエステル樹脂よりなるプラスチック成形体の口頸部の内外面に赤外線を放射して、口頸部を当該熱可塑性ポリエステル樹脂のガラス転移点以上の温度に加熱した後、マイクロ波空洞共振器の中で結晶化温度に誘電加熱し、その後加熱を止めて結晶化を進行させ、次いで口頸部を急冷することを特徴とするプラスチック成形体の結晶化方法。

【請求項3】 口頸部の外側を、内面が回転面よりなる中空赤外線ヒータで包囲し、口頸部の内部に円筒形の赤外線ヒータを挿入して口頸部に赤外線を放射する、請求項1、2記載のプラスチック成形体の結晶化方法。

【請求項4】 口頸部の外側の一部分に赤外線ヒータを配設し、口頸部の内部に円筒形の赤外線ヒータを挿入した状態において、口頸部を自転させて口頸部に赤外線を放射する、請求項1、2記載のプラスチック成形体の結晶化方法。

【請求項5】 口頸部の外側の赤外線ヒータの表面温度が、口頸部の内部の赤外線ヒータの表面温度より高い、請求項3、4記載のプラスチック成形体の結晶化方法。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】 本発明は、プラスチック成形体の口頸部の結晶化方法に関し、さらに詳しくは熱可塑性ポリエステル樹脂よりなるプラスチック成形体の口頸部に赤外線を放射するプラスチック成形体の口頸部の結晶化方法に関する。

【0002】

【従来の技術】 ポリエチレンテレフタレート等の熱可塑性ポリエステル樹脂よりなるプラスチック成形体の口頸部は成形されたままの状態では透明で、大部分が非結晶部であるため、比較的軟らかく、そのため端面に異物が当たって傷が付いたり、あるいは充填、封緘の際に口頸部全体もしくはねじ部等が変形して、密封性が損なわれ易い。この欠点を解消するため、口頸部に外部から赤外線を照射するか、あるいは熱風を吹き付けるか、もしくは口頸部の外面に加熱体を接触させて、口頸部を約110～180℃に加熱して口頸部を結晶化する方法が提案されている（例えは特開昭60-159008号公報、特開昭61-79627号公報）。しかしながら従来の方法の場合、結晶化に1分以上の時間がかかり、生産性が悪く、またエネルギーコストが高いという問題があった。結晶化の時間を短くしようとして口頸部と赤外線照射体を接近させたり、あるいは赤外線照射体や熱風または加熱体の温度を高くすると、外面が過熱状態になって

ねじ部等の形状が崩れて、キャップによる封緘が困難になるという問題があった。

【0003】

【発明が解決しようとする課題】 本発明は、ねじ部等の形状を正常に保ったまま、極く短時間に、ポリエチレンテレフタレート等の熱可塑性ポリエステル樹脂よりなるプラスチック成形体の口頸部を結晶化する方法を提供することを目的とする。

【0004】

【課題を解決するための手段】 請求項1に係る発明は、熱可塑性ポリエステル樹脂よりなるプラスチック成形体の口頸部の内外面に赤外線を放射して、口頸部を結晶化温度に加熱した後、加熱を止めて結晶化を進行させ、次いで口頸部を急冷することを特徴とするプラスチック成形体の結晶化方法である。熱可塑性ポリエステル樹脂としては、ポリエチレンテレフタレートまたはポリエチレンテレフタレートを主成分とするポリエステル樹脂が好ましく用いられる。プラスチック成形体としては、プリフォーム（細長い有底円筒状の予備成形体）や、パリソンからブロー成形または延伸ブロー成形等によって形成されたボトル等が挙げられる。結晶化温度は、すなわち結晶化が進行する温度はある温度領域を有する。ポリエチレンテレフタレートの場合、この温度領域は約160～200℃であり、190℃までは温度が高くなる程結晶化速度が大きくなり、190℃を越えると結晶化速度が低下する。温度が高くなり過ぎると、部分的溶融が進行するのと、その温度まで加熱するのに要する時間が長くなる。ポリエチレンテレフタレートの場合、部分的溶融が起こらないで、しかも結晶化速度が最も大きい温度（最適結晶化温度とよぶ）は、約180℃、すなわち180℃±5℃、より好ましくは180℃±3℃である。

【0005】 口頸部の内外面に赤外線を放射する、すなわち口頸部の内面と外面に同時に赤外線を放射するのであるから、結晶化温度が高い場合でも、すなわち最適結晶化温度の場合でも、口頸部の全厚を急速に結晶化温度に加熱できる。結晶化温度が高い場合、特に最適結晶化温度の場合、加熱を止めて短時間の間は口頸部は結晶化温度領域内にあるので、この間結晶化が進行する。従ってねじ部等の形状を正常に保ったまま、極く短時間に口頸部を結晶化することができる。結晶化温度に短時間保持し、その後直ちに口頸部を急冷する。この場合ガラス転移温度より低い温度まで急冷することにより、後工程で異物が当たったりしても口頸部が傷付いたり、変形するおそれがなくすることができる。

【0006】 請求項2に係る発明は、熱可塑性ポリエスチル樹脂よりなるプラスチック成形体の口頸部の内外面に赤外線を放射して、口頸部を当該熱可塑性ポリエスチル樹脂のガラス転移点以上の温度に加熱した後、マイクロ波空洞共振器の中で結晶化温度に誘電加熱し、その後

加熱を止めて結晶化を進行させ、次いで口頸部を急冷することを特徴とするプラスチック成形体の結晶化方法である。赤外線放射加熱による温度上昇速度は、ブリフォームすなわち口頸部の温度が高くなる程小さくなる。一方誘電加熱による温度上昇速度は、ガラス転移点以上の温度において口頸部の温度が高くなる程大きくなる。そのため請求項2に係る発明の場合、請求項1に係る発明の場合よりも急速に結晶化温度、好ましくは最適結晶化温度に加熱することができる。

【0007】請求項3に係る発明は、口頸部の外側を、内面が回転面よりなる中空赤外線ヒータで包囲し、口頸部の内部に円筒形の赤外線ヒータを挿入して口頸部に赤外線を放射する、請求項1、2記載のプラスチック成形体の結晶化方法である。口頸部の外側を、内面が回転面よりなる中空赤外線ヒータで包囲し、口頸部の内部に円筒形の赤外線ヒータを挿入して口頸部に赤外線を放射するのであるから、外側の赤外線ヒータと内部の赤外線ヒータを口頸部と同軸に配設することにより、また回転面の高さ方向形状を適当に定めることにより、静止した状態で口頸部を均一に、特に周方向均一に加熱することができる。

【0008】請求項4に係る発明は、口頸部の外側の一部分に赤外線ヒータを配設し、口頸部の内部に円筒形の赤外線ヒータを挿入した状態において、口頸部を自転させて口頸部に赤外線を放射する、請求項1、2記載のプラスチック成形体の結晶化方法である。口頸部の外側の一部分に赤外線ヒータを配設しているが、口頸部の内部に円筒形の赤外線ヒータを挿入し、口頸部を自転させて口頸部に赤外線を放射するので、口頸部を均一に、特に周方向均一に加熱することができる。

【0009】請求項5に係る発明は、口頸部の外側の赤外線ヒータの表面温度が、口頸部の内部の赤外線ヒータの表面温度より高い、請求項3、4記載のプラスチック成形体の結晶化方法である。口頸部の内面は、赤外線ヒータとの間の間隙を通って、加熱された内面部分から放射される赤外線により加熱し合うので、外面よりも加熱速度が速い。従って口頸部の外側の赤外線ヒータの表面温度が、口頸部の内部の赤外線ヒータの表面温度より高い場合は、口頸部の内面と外面をほぼ同一速度で加熱する、すなわちほぼ均等に加熱することができる。

[0010]

【発明の実施の形態】第1の実施の形態を示す図1において、ポリエチレンテレフタレートよりなる、射出成形により形成されたプリフォーム1は、口頸部2、円筒形の胴部3および半球面状の底部4よりなっている。口頸部2には、上方にねじ部2aが、最下部に保持リング2bが形成されている。保持リング2bは、プリフォーム1から形成されたボトル(図示されない)のねじ部2aにキャップ(図示されない)を封緘する際に、保持体(図示されない)と併合してプリフォーム1を支持する

(図示されない) と係合してプリフォーム 1 を支持する

ために設けられるものであり、ねじ部 2 a より大きい外径を有する。プリフォーム 1 は、コイルスプリング 6 を介して保持板 5 の上に着設された、底部 4 の外面と同形の上面を有する支持体 7 の上に、軸心を垂直にして載置されている。保持板 5 は、シャフト 5 a によって支持されている。10 は、胴部 3 の上部、すなわち保持リング 2 b 近傍部が赤外線によって加熱されるのを防ぎ、かつプリフォーム 1 が大きく傾くのを妨げるため、赤外線ヒータ 8 と同軸に保持板 5 に着設された、金属例えはアルミニウムよりなる遮蔽筒である。遮蔽筒 10 の上部の細径部 10 a の内径は、プリフォーム 1 の挿入が容易に行なわれ、かつプリフォーム 1 が大きく傾かない程度に、胴部 3 の外径より僅かに大きい。保持板 5 およびシャフト 5 a 等は、間欠回転するターレット（図示されない）の各ポケットに設けている。

【0011】8は、電熱線9がスパイラル状に内設された、高さおよび内径が口頸部2より若干大きい中空円筒形の赤外線セラミックヒータであって、口頸部2と同軸に口頸部2を包围している。赤外線セラミックヒータ8の内面8aの温度は、約500～1000℃であることが好ましい。11は、口頸部2の内側にあって、口頸部2と同軸の赤外線カートリッジヒータであって、外径が口頸部2の内径より若干小さい有底中空の真鍮製円筒体の内部に、セラミックロッド13に巻付けられた電熱線12が設けられている。赤外線カートリッジヒータ11の外面温度は、約300～800℃であり、かつ赤外線セラミックヒータ8の内面8aの温度より低いことが好ましい。赤外線ヒータ8とカートリッジヒータ11は、前記ターレットの加熱ステーションの上方の定位置に、

30 停止したプリフォーム1と同軸に配設されるようになっている。なお赤外線ヒータ8の内面は、例えば8'aに示されるような適宜の形状の回転面であってよい。口頸部2が均一に加熱されるためには、赤外線ヒータ8の内面と口頸部2との半径方向間隔は、保持リング2bの部分がねじ部2aの部分より小さいことが好ましい。保持リング2bの単位高さ当たりの体積、すなわち熱容量は、ねじ部2aのそれよりも大きいからである。

【0.012】以上の装置により、プリフォーム1の口頸部2の結晶化は次のようにして行なわれる。前記ターレットのプリフォーム送入ステーション(図示されない)において、シャフト5aが下降、停止している状態において、プリフォーム1を支持体7の上に落下、載置する。コイルスプリング6は落下の際に緩衝の役目をする。ターレットの回転に伴ない、プリフォーム1が加熱ステーション(図示されない)に達して停止した時、図1に示すように、同軸に定位位置に配設された赤外線ヒータ8とカートリッジヒータ11の間に口頸部2が来るまでシャフト5aを上昇させる。赤外線ヒータ8の内面温度は例えば $800 \pm 10^\circ\text{C}$ に、カートリッジヒータ11の外面温度は例えば $500 \pm 5^\circ\text{C}$ に保たれている。この

場合ターレットが極く短時間例えは約13秒間停止して口頸部2が約180℃に加熱される。この間プリフォーム1を停止したままおく。しかし図示されない回転機構によってシャフト5aを回転して、プリフォーム1を軸心の周りに自転させてもよい。直ちにシャフト5aを下降して、口頸部2の加熱を停止し、プリフォーム1はターレットと共に回動して、整形ステーションまで移動する。この間口頸部2は自然放冷により約5～10℃温度が低下するが、その温度は結晶化温度内にあるので、結晶化が進行する。整形ステーションにおいて、停止した口頸部2内に室温の整形金具（図示されない）を挿入して、結晶化により僅かに収縮変形した口頸部2を整形すると同時にガラス転移温度（通常約75～80℃）より低い温度まで急冷する。

【0013】第2の実施の形態を示す図2において、図1と同一符号の部分は同様の部分を示す。但しカートリッジヒータ11は上下動可能になっており、シャフト5aは直線方向への移動および回転が可能になっている。

15 5は図面に直角方向に延びる近赤外線ランプ（クオーツヒータ）であって、口頸部2の上部と下部に対向する位置に2本配設されている。16は断面U字形の反射鏡であって、近赤外線ランプ15が口頸部2の近赤外線ランプ15側の面に集光する位置に、図面に直角方向に延びて配設されている。17は図面に直角方向に延びる赤外線遮蔽板である。シャフト5aは図示されない移動機構により図面に直角方向に移動可能になっており、従ってプリフォーム1も図面に直角方向に移動可能になっている。カートリッジヒータ11もシャフト5aに連動して、プリフォーム1と同軸を保ったまま、移動機構（図示されない）によってプリフォーム1と共に移動するようになっている。さらにシャフト5aは、少なくとも移動中回転機構（図示されない）によって回転するようになっており、従ってプリフォーム1は移動中自転する。

【0014】以上の装置により、プリフォーム1の口頸部2の結晶化は次のようにして行なわれる。支持体7の上にプリフォーム1を落下、載置した後、カートリッジヒータ11を口頸部2に挿入し、シャフト5aを回転しながらカートリッジヒータ11と共に移動させて、赤外線ランプ15により口頸部2の外面を、またカートリッジヒータ11により口頸部2の内面を急速に約180℃になるまで加熱する。その後カートリッジヒータ11を上昇させて、口頸部2から離隔し、同時に口頸部2を赤外線放射域から離脱させ、口頸部2を短時間自然放冷して、約160～180℃の温度で結晶化を進行させる。結晶化終了後、口頸部2内に成形金具（図示されない）を挿入して、結晶化により僅かに収縮変形した口頸部2を整形すると同時に急冷する。

【0015】図3において、図2と同一符号の部分は同様の部分を示す。20は、円筒形セラミック22で被覆された鉄（鋼）芯21よりなり、保持ロッド20aを介

して上下動される、プリフォーム1の口頸部2の内径より外径が若干小さい赤外線内部ヒータである。23は、赤外線ランプ15の入口部において停止するプリフォーム1および赤外線内部ヒータ20と同軸に、かつプリフォーム1の上方定位位置に配設された、赤外線内部ヒータ20を包囲して加熱する、高周波誘導コイルである。高周波誘導コイル23は、高周波発振器24に接続し、高周波発振器24の出力は、放射温度計25に接続する温度調節器26によって制御され、赤外線内部ヒータ20の外面温度が所定値に保たれるようになっている。移動して赤外線ランプ15の入口部において停止したプリフォーム1の口頸部2内に、保持ロッド20aを介して赤外線内部ヒータ20が挿入される。挿入された赤外線内部ヒータ20は、プリフォーム1と同軸にプリフォーム1と共に移動するようになっている。図2のカートリッジヒータ11が赤外線内部ヒータ20に代わっただけであるから、図3の装置によるプリフォーム1の口頸部2の結晶化は段落番号0014に記載の方法とほぼ同様である。

【0016】第3の実施の形態を示すための図4において、図2と同一符号の部分は同様の部分を示す。30はマイクロ波空洞共振器であり、右端のフランジ部31側からマイクロ波32が伝送され、先端部30aに1個の高電界域（図示されない）が形成されるようにサイズが定められている。プリフォーム1の口頸部2が、空洞共振器30に直角方向に移動して高電界域を通過し得るように、先端部30aの両側部に方形のスロット33が形成されている。

【0017】空洞共振器30を併用する口頸部2の結晶化は、例えは次のようにして行なわれる。段落番号0014（図2）に記載したようにして、先づ口頸部2を、180℃より低く、ポリエチレンテレフタレートのガラス転移点以上の温度例えは約120℃まで急速に加熱した後、口頸部2を空洞共振器30の入口側スロット33を通って空洞共振器30の高電界域に、極く短時間例えは約3秒間停止させ、口頸部2を約180℃に誘電加熱する。その後空洞共振器30の出口側スロット33を通って空洞共振器30から出し、大気中に例えは約20秒間置いて放冷し、約160～180℃で結晶化を進行させる。結晶化終了後、口頸部2内に成形金具（図示されない）を挿入して、結晶化により僅かに収縮変形した口頸部2を整形すると同時に急冷する。

【0018】

【実施例】実施例1：図1に示す、内径が45mm、高さが40mmの赤外線セラミックヒータ8（内面温度850℃）および外径が8mm、長さが50mmのカートリッジヒータ11（外面温度500℃）を用いて、口頸部2の高さが25mm、内径が20mm、支持リング2bの外径が34mmの、ポリエチレンテレフタレートよりなるプリフォーム1の口頸部2を加熱した。遮蔽筒1

0の端面と支持リング2 bの下面との間隔は5 mmであった。段落番号0012に記載の方法で、口頸部2を13秒加熱して、口頸部2の温度が180℃になった後、170℃になるまで20秒間自然放冷した。直ちに口頸部2に室温の整形金具を10秒間挿入して口頸部2を急冷した。この場合の時間と温度との関係を図5に示す。温度測定は放射温度計によって行なった。口頸部2は全体が白化して結晶化した。結晶化度を測定した所、41%であった。ねじ部2 aおよび支持リング2 bの形状は正常であった。

【0019】実施例2：カートリッジヒータ11の外面温度を800℃にし、加熱時間を10秒にして口頸部2の温度を180℃に加熱した点以外は、実施例1と同様にして口頸部2の結晶化を行なった。口頸部2は全体が白化して結晶化した。結晶化度を測定した所、40%であった。ねじ部2 aおよび支持リング2 bの形状は正常であった。

【0020】実施例3：図2に示すように、近赤外線ランプ15(2 kW/1本)とセラミック製反射鏡16を用い、プリフォーム1を自転させながらランプ15に沿って移動させた点以外は、実施例1と同様の加熱条件で、すなわち図5に示す加熱、放冷、急冷速度で口頸部2の結晶化を行なった。なお近赤外線ランプ15と口頸部2との間隔は、3.5 cmであった。口頸部2は全体が白化して結晶化した。結晶化度を測定した所、38%であった。ねじ部2 aおよび支持リング2 bの形状は正常であった。

【0021】実施例4：図3に示す赤外線内部ヒータ20(外面温度500℃；外径8 mm)をカートリッジヒータ11の代わりに用いた点以外は、実施例3と同様にして口頸部2を加熱した。口頸部2は全体が白化して結晶化した。結晶化度を測定した所、38%であった。ねじ部2 aおよび支持リング2 bの形状は正常であった。

【0022】実施例5：加熱時間以外は実施例1と同様にして、口頸部2を6秒加熱した。加熱後の口頸部2の温度は120℃であった。直ちに口頸部2を、図4に示すマイクロ波空洞共振器30で3秒間誘電加熱して、口頸部2の温度を180℃に上昇させた。マイクロ波空洞共振器30には、周波数2450 MHz、出力5 kWのマイクロ波発振器(図示されない)が接続し、マイクロ波空洞共振器30の出力は2.7 kWであった。マイクロ波誘電加熱後20秒大気中で自然放冷し160~180℃で結晶化を進行させた後、直ちに口頸部2に室温の整形金具を10秒間挿入して口頸部2を急冷した。口頸部2は全体が白化して結晶化した。結晶化度を測定した所、40%であった。ねじ部2 aおよび支持リング2 bの形状は正常であった。

【0023】比較例：カートリッジヒータ11を用いな

かった点以外は実施例1と同様にして、口頸部2の加熱を行なった。しかし口頸部2は120℃までしか温度上昇しなかったので、口頸部2の結晶化は行なわれなかつた。

【0024】

【発明の効果】請求項1に係わる発明は、ねじ部等の形状を正常に保ったまま、極く短時間にプラスチック成形体の口頸部を結晶化することができるという効果を奏する。従つて生産性が高く、かつエネルギーコストが低い

10 という利点を有する。請求項2に係わる発明は、ねじ部等の形状を正常に保ったまま、更に極く短時間にプラスチック成形体の口頸部を結晶化することができるという効果を奏する。請求項3に係わる発明は、請求項1、2の効果に加えて、中空赤外線ヒータおよび円筒形の赤外線ヒータとプラスチック成形体を同軸にすることにより、プラスチック成形体を静止した状態で口頸部を均一に加熱することができるという利点を有する。請求項4に係わる発明は、請求項1、2の効果に加えて、プラスチック成形体を自転させることにより、口頸部を均一に加熱することができるという利点を有する。請求項5に係わる発明は、請求項3、4の効果に加えて、口頸部の内外面をほぼ均等に加熱することができるというメリットを有する。

【図面の簡単な説明】

【図1】本発明の第1の実施の形態を示す図面であつて、プリフォームの口頸部を加熱している状態を示す縦断面図である。

【図2】本発明の第2の実施の形態を示す図面であつて、プリフォームの口頸部を加熱している状態を示す縦断面図である。

【図3】本発明の第2の実施の形態を示す他の態様の図面であつて、プリフォームの口頸部を加熱している状態を示す縦断面図である。

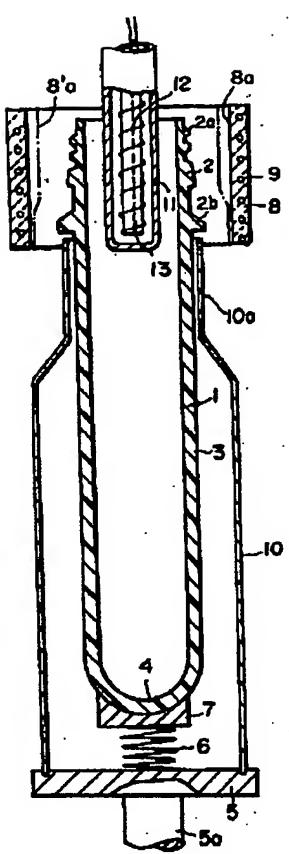
【図4】本発明の第3の実施の形態の一部を示す図面であつて、プリフォームの口頸部を誘電加熱している状態を示す正面図である。

【図5】本発明の方法により結晶化する場合の、口頸部の温度と時間の関係の例を示す線図である。

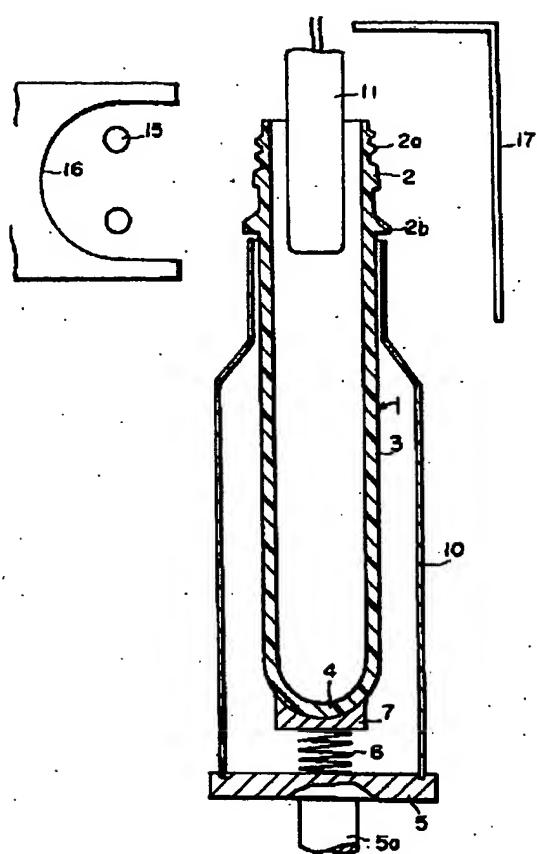
【符号の説明】

40	1	プリフォーム(プラスチック成形体)
	2	口頸部
	8	セラミック赤外線ヒータ(中空赤外線ヒータ)
	11	カートリッジヒータ(円筒形の赤外線ヒータ)
	15	赤外線ランプ(赤外線ヒータ)
	20	赤外線内部ヒータ(円筒形の赤外線ヒータ)
	30	マイクロ波空洞共振器

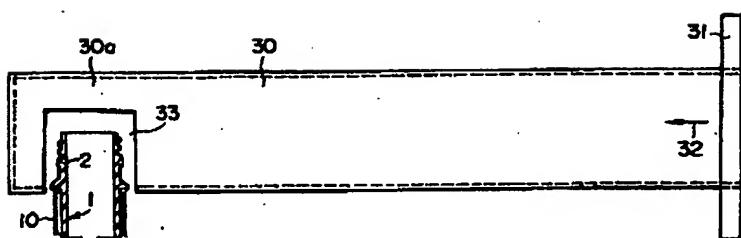
【図1】



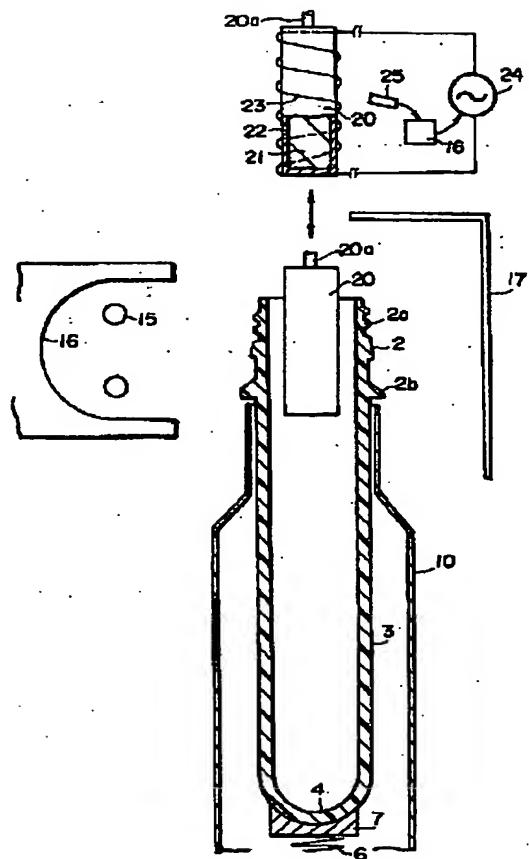
【図2】



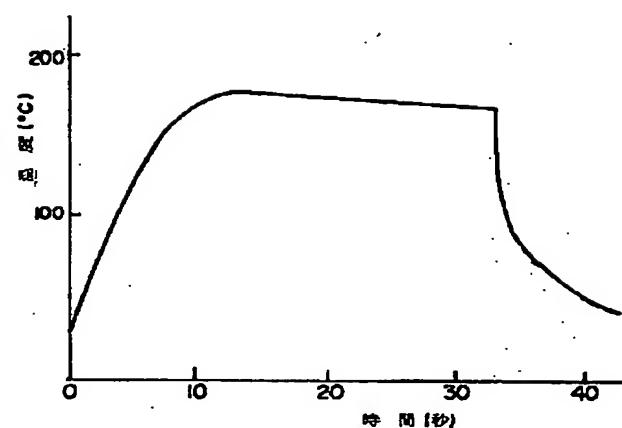
【図4】



【図3】



【図5】



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CLAIMS

[Claim(s)]

[Claim 1] The crystallization approach of the plastics Plastic solid characterized by stopping heating, advancing crystallization and subsequently quenching the opening neck after emitting infrared radiation to the inside-and-outside side of the opening neck of the plastics Plastic solid which consists of thermoplastic polyester resin and heating the opening neck to crystallization temperature.

[Claim 2] The crystallization approach of the plastics Plastic solid characterized by carrying out dielectric heating to crystallization temperature in a microwave cavity resonator, stopping the afterbaking, advancing crystallization, and subsequently quenching the opening neck after emitting infrared radiation to the inside-and-outside side of the opening neck of the plastics Plastic solid which consists of thermoplastic polyester resin and heating the opening neck to the temperature more than the glass transition point of the thermoplastic polyester resin concerned.

[Claim 3] The crystallization approach of of the claim 1 and the plastics Plastic solid of two publications which surround the outside of the opening neck at the hollow infrared heater at which an inside consists of surface of revolution, insert the infrared heater of a cylindrical shape in the interior of the opening neck, and emit infrared radiation to the opening neck.

[Claim 4] The crystallization approach of of the claim 1 and the plastics Plastic solid of two publications which arrange an infrared heater in a part of outside of the opening neck, and the opening neck is made to rotate and emit infrared radiation to the opening neck in the condition of having inserted the infrared heater of a cylindrical shape in the interior of the opening neck.

[Claim 5] Claim 3, the crystallization approach of the plastics Plastic solid four publications that the skin temperature of the infrared heater of the outside of the opening neck is higher than the skin temperature of the infrared heater inside the opening neck.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the crystallization approach of the opening neck of the plastics Plastic solid which emits infrared radiation to the opening neck of the plastics Plastic solid which consists of thermoplastic polyester resin in more detail about the crystallization approach of the opening neck of a plastics Plastic solid.

[0002]

[Description of the Prior Art] In the condition [that the opening neck of the plastics Plastic solid which consists of thermoplastic polyester resin, such as polyethylene terephthalate, is fabricated], it is transparent, since most is the amorphous section, it is comparatively soft, therefore a foreign matter hits an end face, a blemish is attached, or the whole opening neck or a thread part deforms in the case of restoration and a seal, and sealing performance is easy to be spoiled. In order to cancel this fault, infrared radiation is irradiated from the exterior at the opening neck, hot blast is sprayed, or a heating object is contacted on the external surface of the opening neck, and the approach of heating the opening neck at about 110–180 degrees C, and crystallizing the opening neck is proposed (for example, JP,60-159008,A, JP,61-79627,A). However, in the case of the conventional approach, crystallization took the time amount for 1 minute or more, and there was a problem that energy cost was high, bad [productivity]. When it was going to shorten time amount of crystallization, and the opening neck and an infrared exposure object were made to approach or temperature of an infrared exposure object, or a hot blast or a heating object was made high, external surface would be in overheating, configurations, such as a thread part, collapsed, and there was a problem that a seal with a cap became difficult.

[0003]

[Problem(s) to be Solved by the Invention] This invention aims at offering the approach of crystallizing the opening neck of the plastics Plastic solid which becomes a **** short time from thermoplastic polyester resin, such as polyethylene terephthalate, keeping configurations, such as a thread part, normal. [0004]

[Means for Solving the Problem] After invention concerning claim 1 emits infrared radiation to the inside-and-outside side of the opening neck of the plastics Plastic solid which consists of thermoplastic polyester resin and heats the opening neck to crystallization temperature, it is the crystallization approach of the plastics Plastic solid characterized by stopping heating, advancing crystallization and subsequently quenching the opening neck. As thermoplastic polyester resin, the polyester resin which uses polyethylene terephthalate or polyethylene terephthalate as a principal component is used preferably. As a plastics Plastic solid, the bottle formed of blow molding or extension blow molding is mentioned from preforming (preforming object of the shape of a long and slender closed-end cylinder), and parison. Crystallization temperature, i.e., the temperature to which crystallization advances, has a certain temperature field. In the case of polyethylene terephthalate, this temperature field is about 160–200 degrees C, and to 190 degrees C, if a crystallization rate becomes large and 190 degrees C is exceeded so that temperature becomes high, a crystallization rate will fall. If temperature becomes high too much, the time amount taken that partial melting advances and to heat to the temperature will become long. without partial melting happens in the case of polyethylene terephthalate — the temperature (it is called the optimal crystallization temperature) with the crystallization rate largest moreover — about 180 degrees C — that is, 180 degrees C **5 degrees C are 180 degrees C **3 degrees C more preferably.

[0005] Infrared radiation is emitted to the inside-and-outside side of the opening neck, namely, also in the case of optimal crystallization temperature, since infrared radiation is emitted to the inside and external surface of the opening neck at coincidence, when crystallization temperature is high, the overall thickness of the opening neck can be quickly heated to crystallization temperature. Since

the opening neck is in a crystallization temperature field between short time even if it stops heating when crystallization temperature is high, and it is especially the optimal crystallization temperature, crystallization advances in the meantime. Therefore, the opening neck can be crystallized for a *** short time, keeping configurations, such as a thread part, normal. Short-time maintenance is carried out at crystallization temperature, and the opening neck is quenched immediately after that. In this case, by quenching to temperature lower than glass transition temperature, even if a foreign matter hits at a back process, the opening neck can get damaged, or a possibility of deforming can lose.

[0006] After invention concerning claim 2 emits infrared radiation to the inside-and-outside side of the opening neck of the plastics Plastic solid which consists of thermoplastic polyester resin and heats the opening neck to the temperature more than the glass transition point of the thermoplastic polyester resin concerned, it is the crystallization approach of the plastics Plastic solid which carries out dielectric heating to crystallization temperature in a microwave cavity resonator, and is characterized by stopping the afterbaking, advancing crystallization and subsequently quenching the opening neck. The rate of temperature rise by infrared emission heating becomes so small that the temperature of preforming, i.e., the opening neck, becomes high. On the other hand, the rate of temperature rise by dielectric heating becomes so large that the temperature of the opening neck becomes high in the temperature more than a glass transition point. therefore, the case of invention which relates to claim 1 in invention concerning claim 2 -- rapid -- crystallization temperature -- it can heat to the optimal crystallization temperature preferably. [0007] Invention concerning claim 3 is the crystallization approach of of the claim 1 and the plastics Plastic solid of two publications which surround the outside of the opening neck at the hollow infrared heater at which an inside consists of surface of revolution, insert the infrared heater of a cylindrical shape in the interior of the opening neck, and emit infrared radiation to the opening neck. The outside of the opening neck is surrounded at the hollow infrared heater at which an inside consists of surface of revolution. Since the infrared heater of a cylindrical shape is inserted in the interior of the opening neck and infrared radiation is emitted to the opening neck, by arranging an outside infrared heater and an internal infrared heater in the opening neck and the same axle Moreover, by defining the height direction configuration of surface of revolution suitably, the opening neck can be heated to homogeneity in the condition of having stood it still especially at hoop direction homogeneity.

[0008] Invention concerning claim 4 is the crystallization approach of of the claim 1 and the plastics Plastic solid of two publications which arrange an infrared heater in a part of outside of the opening neck, and the opening neck is made to rotate and emit infrared radiation to the opening neck in the condition of having inserted the infrared heater of a cylindrical shape in the interior of the opening neck. Although the infrared heater is arranged in a part of outside of the opening neck, since insert the infrared heater of a cylindrical shape in the interior of the opening neck, the opening neck is made to rotate and infrared radiation is emitted to the opening neck, the opening neck can be heated to homogeneity especially at hoop direction homogeneity.

[0009] Invention concerning claim 5 is the crystallization approach of of a claim 3 and the plastics Plastic solid of four publications with the skin temperature of the infrared heater of the outside of the opening neck higher than the skin temperature of the infrared heater inside the opening neck. Since the inside of the opening neck heats the gap between infrared heaters mutually with the infrared radiation which passes and is emitted from the heated inside part, its heating rate is quicker than external surface. Therefore, when the skin temperature of the infrared heater of the outside of the opening neck is higher than the skin temperature of the infrared heater inside the opening neck, the inside and external surface of the opening neck can be mostly heated namely, heated almost equally at the same rate.

[0010]

[Embodiment of the Invention] In drawing 1 which shows the gestalt of the 1st operation, the preforming 1 which consists of polyethylene terephthalate and which was formed by injection molding consists of the opening neck 2, a drum section 3 of a cylindrical shape, and a semi-sphere

side-like pars basilaris ossis occipitalis 4. Thread-part 2a is formed up and retaining ring 2b is formed in the bottom at the opening neck 2. In case retaining ring 2b carries out the seal of the cap (not shown) to thread-part 2a of the bottle (not shown) formed from preforming 1, it is prepared in order to engage with a supporter (not shown) and to support preforming 1, and has a larger outer diameter than thread-part 2a. On the base material 7 which was attached on the maintenance plate 5 through the coil spring 6 and which has the external surface of a pars basilaris ossis occipitalis 4, and the top face of isomorphism, preforming 1 makes an axial center perpendicular and is laid. The maintenance plate 5 is supported by shaft 5a. 10 is an electric shielding cylinder which consists of the metal, for example, the aluminum, attached in the infrared heater 8 and the same axle for barring that prevent heating the upper part of a drum section 3, i.e., the section near the retaining ring 2b, by infrared radiation, and preforming 1 inclines greatly by the maintenance plate 5. The bore of thin diameter section 10a of the upper part of the electric shielding cylinder 10 is more slightly [than the outer diameter of a drum section 3] large to extent to which insertion of preforming 1 is easily performed, and preforming 1 does not incline greatly. It prepares in each pocket of the turret (not shown) which carries out intermittent rotation, and the maintenance plate 5, shaft 5a, etc. are *****.

[0011] The height and bore inside which heating wire 9 was installed in the shape of a spiral are the infrared ceramic heater of a larger hollow cylinder form a little than the opening neck 2, and 8 is surrounding the opening neck 2 on the opening neck 2 and the same axle. As for the temperature of inside 8a of the infrared ceramic heater 8, it is desirable that it is about 500-1000 degrees C. 11 is inside the opening neck 2, it is the infrared cartridge heater of the opening neck 2 and the same axle, and the heating wire 12 with which the outer diameter was twisted around the ceramic rod 13 inside the cylinder object [a little] made from brass of closed-end hollow smaller than the bore of the opening neck 2 is formed. The outside temperature of the infrared cartridge heater 11 is about 300-800 degrees C, and it is desirable that it is lower than the temperature of inside 8a of the infrared ceramic heater 8. The infrared heater 8 and a cartridge heater 11 are arranged in the orientation above the heating station of said turret by stopped preforming 1 and the stopped same axle. In addition, the inside of the infrared heater 8 may be the surface of revolution of a proper configuration as shown for example, in 8'a. In order for the opening neck 2 to be heated by homogeneity, as for radial spacing of the inside of the infrared heater 8, and the opening neck 2, it is desirable that the part of retaining ring 2b is smaller than the part of thread-part 2a. The volume per unit height of retaining ring 2b, i.e., heat capacity, is because it is larger than that of thread-part 2a.

[0012] Crystallization of the opening neck 2 of preforming 1 is performed as follows by the equipment of a more than. It sets to the preforming feeding station (not shown) of said turret, sets in the condition that shaft 5a has descended and stopped, and preforming 1 is fallen and laid on a base material 7. A coil spring 6 carries out the duty of a buffer in the case of fall. When preforming 1 arrives at a heating station (not shown) and stops with rotation of a turret, shaft 5a is raised until the opening neck 2 comes between the infrared heater 8 arranged in the orientation by the same axle, and a cartridge heater 11, as shown in drawing 1 R> 1. The inside temperature of the infrared heater 8 is kept at 800**10 degrees C, and the outside temperature of a cartridge heater 11 is kept at 500**5 degrees C. in this case, a turret -- a **** short time -- for example, it stops for about 13 seconds and the opening neck 2 is heated by about 180 degrees C. It sets as preforming 1 was stopped in the meantime. However, shaft 5a may be rotated and preforming 1 may be made to rotate around an axial center by the rolling mechanism which is not illustrated. Shaft 5a is descended immediately, heating of the opening neck 2 is suspended, and preforming 1 rotates with a turret and moves to a plastic surgery station. Although, as for this frontage neck 2, about 5-10-degree-C temperature falls by natural radiation cooling, since that temperature is in crystallization temperature, crystallization advances. At a plastic surgery station, the plastic surgery metallic ornaments (not shown) of a room temperature are inserted into the stopped opening neck 2, and it quenches to temperature lower than glass transition temperature (usually about 75-80

degrees C) at the same time it operates orthopedically the opening neck 2 which carried out contraction deformation slightly by crystallization.

[0013] In drawing 2 which shows the gestalt of the 2nd operation, the part of the same sign as drawing 1 R>1 shows the same part. However, vertical movement of a cartridge heater 11 is attained, and, as for shaft 5a, migration in the direction of a straight line and rotation are attained. 15 is a near infrared ray lamp (quartz watch heater) prolonged in the direction of a right angle on a drawing, and is arranged in the location which counters the upper part and the lower part of the opening neck 2 two. 16 is the reflecting mirror of a cross-section U typeface, and is prolonged for it and arranged in the location which the near infrared ray lamp 15 condenses to the field by the side of the near infrared ray lamp 15 of the opening neck 2 by the drawing in the direction of a right angle. 17 is an infrared shield prolonged in the direction of a right angle on a drawing. Shaft 5a is movable in the direction of a right angle according to the migration device which is not illustrated at the drawing, therefore movable [preforming 1] on a drawing in the direction of a right angle. It moves with preforming 1 according to a migration device (not shown), also interlocking with [a / shaft 5] a cartridge heater 11, and maintaining preforming 1 and the same axle. Furthermore, shaft 5a rotates according to a migration middle turn device (not shown) at least, therefore preforming 1 rotates during migration.

[0014] Crystallization of the opening neck 2 of preforming 1 is performed as follows by the equipment of a more than. After falling and laying preforming 1 on a base material 7, it is made to move with a cartridge heater 11, inserting a cartridge heater 11 in the opening neck 2, and rotating shaft 5a, and the external surface of the opening neck 2 is heated with an infrared lamp 15 until it becomes about 180 degrees C quickly about the inside of the opening neck 2 with a cartridge heater 11 again. Raise a cartridge heater 11 after that, it is isolated from the opening neck 2, the opening neck 2 is made for coincidence to secede from an infrared emission region, short-time natural radiation cooling of the opening neck 2 is carried out, and crystallization is advanced at the temperature of about 160-180 degrees C. Shaping metallic ornaments (not shown) are inserted after crystallization termination and into the opening neck 2, and it quenches at the same time it operates orthopedically the opening neck 2 which carried out contraction deformation slightly by crystallization.

[0015] In drawing 3, the part of the same sign as drawing 2 shows the same part. 20 is an interior heater of infrared radiation a little with an outer diameter smaller than the bore of the opening neck 2 of preforming 1 which consists of the iron (steel) heart 21 covered with the cylindrical shape ceramic 22, and moves up and down through maintenance rod 20a. preforming 1 and the interior heater 20 of infrared radiation which stop 23 in the inlet-port section of an infrared lamp 15, and the same axle -- and it is the RF induction coil which was arranged in the upper part orientation of preforming 1 and which surrounds and heats the interior heater 20 of infrared radiation. The RF induction coil 23 is connected to a high-frequency oscillator 24, the output of a high-frequency oscillator 24 is controlled by the thermoregulator 26 linked to a radiation thermometer 25, and the outside temperature of the interior heater 20 of infrared radiation is maintained at a predetermined value. Into the opening neck 2 of the preforming 1 which was moved and was stopped in the inlet-port section of an infrared lamp 15, the interior heater 20 of infrared radiation is inserted through maintenance rod 20a. The inserted interior heater 20 of infrared radiation moves to preforming 1 and the same axle with preforming 1. Since the cartridge heater 11 of drawing 2 only replaced the interior heater 20 of infrared radiation, crystallization of the opening neck 2 of the preforming 1 by the equipment of drawing 3 is the same as that of an approach given in the paragraph number 0014 almost.

[0016] In drawing 4 to show the gestalt of the 3rd operation, the part of the same sign as drawing 2 shows the same part. 30 is a microwave cavity resonator, a microwave 32 is transmitted from the right end flange 31 side, and size is set that one high electric-field region (not shown) is formed in point 30a. The rectangular slot 33 is formed in the both-sides section of point 30a so that the

opening neck 2 of preforming 1 may move to a cavity resonator 30 in the direction of a right angle and may pass through a high electric-field region.

[0017] Crystallization of the opening neck 2 which uses a cavity resonator 30 together is performed as follows, for example. the opening neck 2 as it indicated for the paragraph number 0014 (drawing 2), after are lower than 180 degrees C and heating the point **** neck 2 quickly to the temperature more than the glass transition point of polyethylene terephthalate, for example, about 120 degrees C, -- the entrance-side slot 33 of a cavity resonator 30 -- passing -- the high electric-field region of a cavity resonator 30 -- a **** short time -- for example, it is made to stop for about 3 seconds, and dielectric heating of the opening neck 2 is carried out to about 180 degrees C. It takes out from a cavity resonator 30 through the outlet side slot 33 of a cavity resonator 30 after that, and it places, for example for about 20 seconds into atmospheric air, and cools radiationally, and crystallization is advanced at about 160-180 degrees C. Shaping metallic ornaments (not shown) are inserted after crystallization termination and into the opening neck 2, and it quenches at the same time it operates orthopedically the opening neck 2 which carried out contraction deformation slightly by crystallization.

[0018]

[Example] Example 1: The infrared ceramic heater 8 (inside temperature of 850 degrees C) and outer diameter which are shown in drawing 1 , whose bore is 45mm and whose height is 40mm heated [8mm and die length / the height of the opening neck 2] the opening neck 2 of preforming 1 whose outer diameter of 20mm and retaining ring 2b 25mm and a bore is 34mm and which consists of polyethylene terephthalate using the cartridge heater 11 (outside temperature of 500 degrees C) which is 50mm. Spacing of the end face of the electric shielding cylinder 10 and the inferior surface of tongue of retaining ring 2b was 5mm. Natural radiationnal cooling during 20 seconds was carried out after it heated the opening neck 2 for 13 seconds and the temperature of the opening neck 2 became 180 degrees C by the approach given in the paragraph number 0012 until it became 170 degrees C. The plastic surgery metallic ornaments of a room temperature were immediately inserted in the opening neck 2 for 10 seconds, and the opening neck 2 was quenched. The relation between the time amount in this case and temperature is shown in drawing 5 . The radiation thermometer performed the thermometry. The whole milked and crystallized the opening neck 2. They were the place which measured degree of crystallinity, and 41%. The configuration of thread-part 2a and retaining ring 2b was normal.

[0019] Example 2: Outside temperature of a cartridge heater 11 was made into 800 degrees C, and the opening neck 2 was crystallized like the example 1 except the point of having heated the temperature of the opening neck 2 at 180 degrees C over 10 seconds for heating time. The whole milked and crystallized the opening neck 2. They were the place which measured degree of crystallinity, and 40%. The configuration of thread-part 2a and retaining ring 2b was normal.

[0020] Example 3: The opening neck 2 was crystallized at heating which is the same heating conditions as an example 1, namely, is shown in drawing 5 , radiationnal cooling, and a quenching rate except the point to which it was made to move along with a lamp 15, making preforming 1 rotate using the near infrared ray lamp 15 (2kw/1) and the reflecting mirror 16 made from a ceramic as shown in drawing 2 . In addition, spacing of the near infrared ray lamp 15 and the opening neck 2 was 3.5cm. The whole milked and crystallized the opening neck 2. They were the place which measured degree of crystallinity, and 38%. The configuration of thread-part 2a and retaining ring 2b was normal.

[0021] Example 4: The opening neck 2 was heated like the example 3 except the point of having used the interior heater 20 (; with an outside temperature of 500 degrees C outer diameter of 8mm) of infrared radiation shown in drawing 3 instead of the cartridge heater 11. The whole milked and crystallized the opening neck 2. They were the place which measured degree of crystallinity, and 38%. The configuration of thread-part 2a and retaining ring 2b was normal.

[0022] Example 5: The opening neck 2 was heated for 6 seconds like the example 1 except heating

time. The temperature of the opening neck 2 after heating was 120 degrees C. Dielectric heating was immediately carried out for 3 seconds with the microwave cavity resonator 30 which shows the opening neck 2 to drawing 4, and the temperature of the opening neck 2 was raised at 180 degrees C. The frequency of 2450MHz and the microwave oscillator (not shown) of output 5kw connected with the microwave cavity resonator 30, and the outputs of the microwave cavity resonator 30 were 2.7kw(s). After carrying out natural radiation cooling in after [micro wave dielectric heating] 20-second atmospheric air and advancing crystallization at 160-180 degrees C, the plastic surgery metallic ornaments of a room temperature were immediately inserted in the opening neck 2 for 10 seconds, and the opening neck 2 was quenched. The whole milked and crystallized the opening neck 2. They were the place which measured degree of crystallinity, and 40%. The configuration of thread-part 2a and retaining ring 2b was normal. [0023] The example of a comparison: The opening neck 2 was heated like the example 1 except the point of having not used a cartridge heater 11. However, since the temperature rise of the opening neck 2 was carried out only to 120 degrees C, crystallization of the opening neck 2 was not performed.

[0024]

[Effect of the Invention] Invention concerning claim 1 does so the effectiveness that the opening neck of a plastics Plastic solid can be crystallized for a **** short time, keeping configurations, such as a thread part, normal. Therefore, productivity has highly the advantage that energy cost is low. Invention concerning claim 2 does so the effectiveness that the opening neck of a plastics Plastic solid can be further crystallized for a **** short time, keeping configurations, such as a thread part, normal. In addition to the effectiveness of claims 1 and 2, invention concerning claim 3 has the advantage that the opening neck can be heated to homogeneity in the condition of having stood the plastics Plastic solid still, by making a hollow infrared heater and the infrared heater of a cylindrical shape, and a plastics Plastic solid into the same axle. In addition to the effectiveness of claims 1 and 2, invention concerning claim 4 has the advantage that the opening neck can be heated to homogeneity, by making a plastics Plastic solid rotate. In addition to the effectiveness of claims 3 and 4, invention concerning claim 5 has the merit that the inside-and-outside side of the opening neck can be heated almost equally.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the drawing in which the gestalt of operation of the 1st of this invention is shown, and is drawing of longitudinal section showing the condition of heating the opening neck of preforming.

[Drawing 2] It is the drawing in which the gestalt of operation of the 2nd of this invention is shown, and is drawing of longitudinal section showing the condition of heating the opening neck of

preforming.

[Drawing 3] It is drawing of longitudinal section in which being the drawing of other modes in which the gestalt of operation of the 2nd of this invention is shown, and showing the condition of heating the opening neck of preforming.

[Drawing 4] It is the drawing in which a part of gestalt of operation of the 3rd of this invention is shown, and is the front view showing the condition of carrying out dielectric heating of the opening neck of preforming.

[Drawing 5] It is the diagram showing the example of the temperature of the opening neck in the case of crystallizing by the approach of this invention, and the relation of time amount.

[Description of Notations]

1 Preforming (Plastics Plastic Solid)

2 Opening Neck

8 Ceramic Infrared Heater (Hollow Infrared Heater)

11 Cartridge Heater (Infrared Heater of Cylindrical Shape)

15 Infrared Lamp (Infrared Heater)

20 Interior Heater of Infrared Radiation (Infrared Heater of Cylindrical Shape)

30 Microwave Cavity Resonator

[Translation done.]

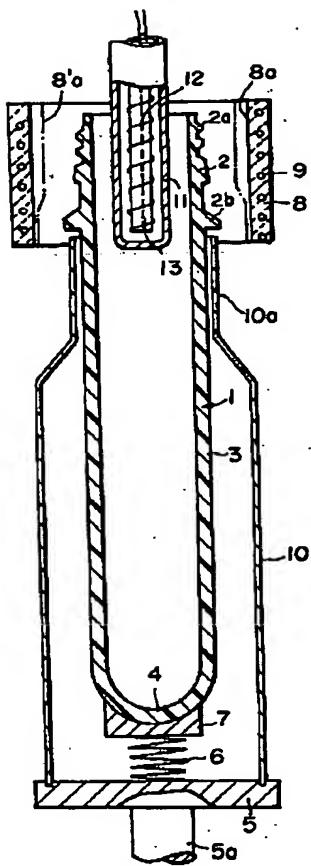
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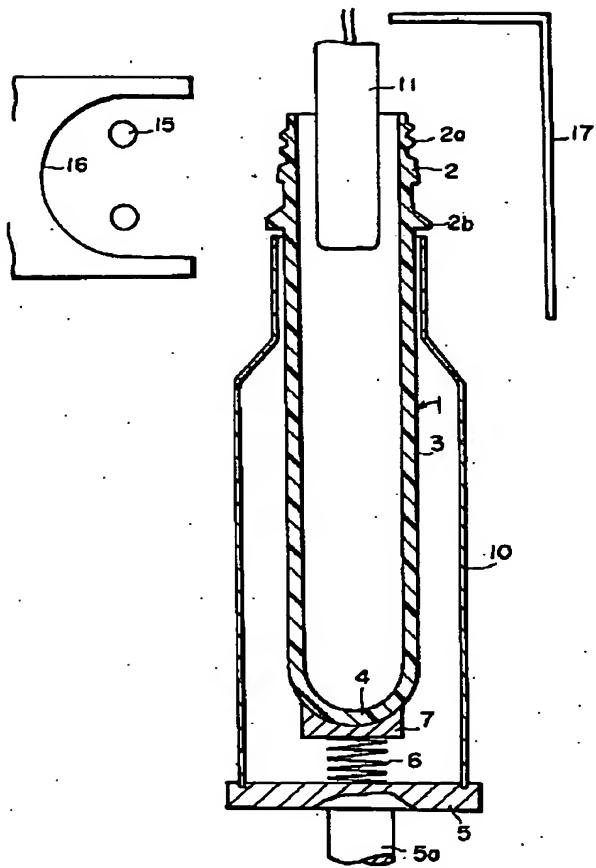
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DRAWINGS

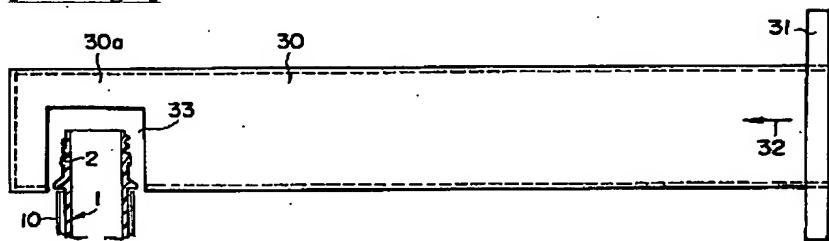
[Drawing 1]



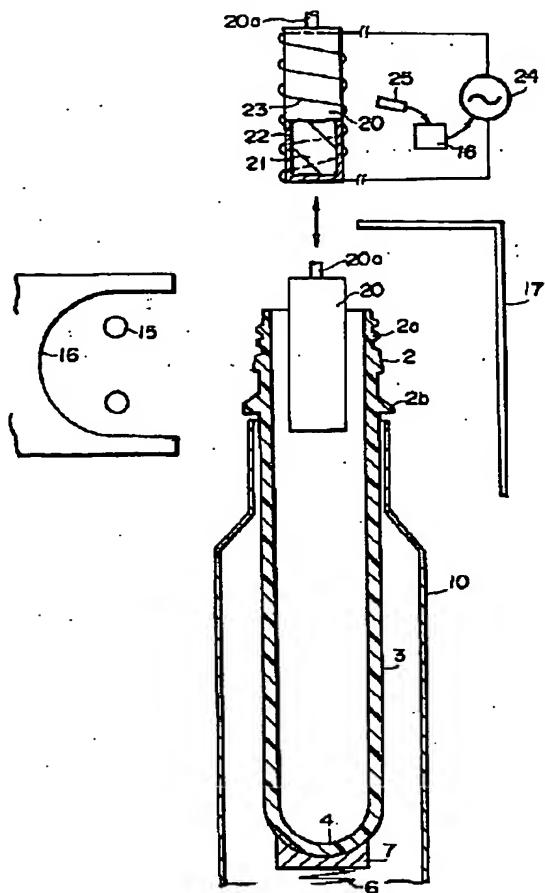
[Drawing 2]



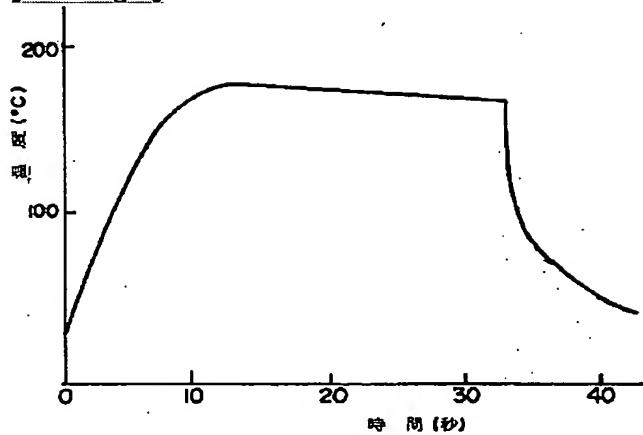
[Drawing 4]



[Drawing 3]



[Drawing 5]



[Translation done.]